SIX MISUNDERSTOOD SPECIES OF AMANITA*

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Recent monographs of the Amanitas have not lessened the obstacles in the way of recognizing the species of this difficult genus. On the contrary, they have introduced certain elements of confusion. This is evidenced by a compression of the number of species in regions where there has not been an opportunity of studying living plants but only dried material has been examined. In quite restricted localities where intensive studies have been made there has occurred a lively splitting process resulting in the multiplication of species based to some extent on trivial characters, the result of environmental and growth influence. I wish here to call attention to several of the species which have been misunderstood.

Among the pure white Amanitas in the eastern United States there is one species which is easily recognized from all the others usually on sight, but with certainty after a microscopic examination. This is *Amanita bisporigera*.† It is a species with a white volva with apical dehiscence and a prominent limb. The pileus is smooth, viscid, and glistening white. The stem is pure white and slender. The basidia are constantly two-spored. The spores are globose or subglobose.

Its nearest ally is a similar white species with four globose spores to a basidium. This four-spored species is a robust plant, interpreted in this country by some as *Amanita verna*, by others as a white form of *A. phalloides*.‡ *Amanita bisporigera* is dis-

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* Illustrated by lantern slides.

† *Amanita bisporigera* Atkinson. Bot. Gaz. **41**: 348. 1906.

‡ *Amanita bisporigera* is placed in *Amanita phalloides* by Murrill (Mycologia **4**: 240. 1912; and N. Am. Fl. **10**: 70. 1914), although very different from the typical *Amanita phalloides* of Europe. Coker (Coker, W. C., The Amanitas of the Eastern United States. Jour. Elisha Mitchell Sci. Soc. **33**: 1–88. *pl. 1–69.* 1917) places *Amanita bisporigera* as a synonym of *Amanita "verna."* This four-spored white *Amanita* of North America was also interpreted by me as *Amanita verna* (see

tinguished from the robust, white, 4-spored species, not only by its 2-spored basidia, but by its more slender form. In nearly all cases one can distinguish it by size alone from small forms of the robust, 4-spored species, without a microscopic examination. However, in several hundred specimens I have examined during the last ten or more years I have not found a single case of a variation in the 2-spored character of the basidia. It is a very distinct genetic type and represents a good species. This interpretation is reinforced by the fact that, in several of the genera of the agarics, there are a number of constantly 2-spored species.

Another species, *Amanita cothurnata*,* is interpreted by some as specifically identical with *Amanita pantherina*.† *Amanita cothurnata* is entirely white, or, rarely, in some individuals there is a tinge of umber over the center of the pileus, or now and then individuals are found with a slight tinge of yellow at the center. The volva is circumscissile in both species. The white calyptra is torn into small floccose patches which are distributed quite regularly over the surface of the pileus. In *Amanita pantherina* the pileus is a dark smoky brown, and these white patches on the dark background are suggestive of the spotted appearance of the panther, whence the name *pantherina*. The lower part of the volva in both species is "cothurnate" or "booted" concrete with the stem, the "limb" in *Amanita cothurnata* terminating in a thick, regular shoulder or roll, like the top of a closely fitting buskin. This species differs from *Amanita pantherina* chiefly in its color, and in its more slender habit, as can be seen from these lantern-slide reproductions of photographs.

At maturity the granular content of the oval, or short-ellipsoid spores usually disappears and is replaced by a large globose oil drop of about the same dimensions as the transverse diameter of the spore. This large glistening oil drop is very distinct in contrast with the nearly transparent, thin, spore wall, which is rather

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Studies of Am. Fungi, Mushrooms, Edible, etc., 1st edition, p. 60. *f. 59.* 1900; 2d ed. 1901). It is, however, quite different from the *Amanita verna* of France (*Agaricus vernus* Fr. ex Bull. Champ. Fr. *pl. 108*) as I have found from specimens since collected in France.

* *Amanita cothurnata* Atkinson, Stud. Am. Fungi, Mushrooms, etc., 1st edition, p. 66. *f. 68, 69.* 1900; 2d ed. 1901.

† Coker, W. C. Jour. Elisha Mitchell Sci. Soc. **33**: 46. 1917.

difficult to see. In specimens of *Amanita pantherina*, which I have collected in the Jura mountains in France,* the spores at maturity, or in dried plants, still retain the granular content. This condition, however, may possibly vary in some specimens, and the presence or absence of an oil drop in the spores, may not be so important a specific character as is usually assumed. But it is worthy of note that in all specimens of *Amanita cothurnata* which I have examined, this change in the spore has taken place. Another witness of the specific distinction of *Amanita cothurnata* is its wide distribution, comparative abundance, and constancy in character, while typical *Amanita pantherina* is quite rare in this country according to my observations. Some of the few individuals which I have found of this species in the United States raise some doubt as to their specific identity with *Amanita pantherina* of Europe, and resemble strongly in some respects another American species, *Amanita velatipes*. Since the latter species is interpreted by one student as synonymous with *Amanita baccata* of Europe, it is readily seen to what an end such indiscriminate "lumping" would lead.

Several other American species have recently† been added as synonyms to quite a long array of names of European forms, cumulatively assembled under *Amanita jonquillea* Quelet and *Amanita baccata* Fr. I will discuss here only two of these, which are not only specifically distinct from each other, but also from *Amanita jonquillea*. These are *Amanitopsis albocreata*,‡ and *Amanita velatipes*.§

Amanitopsis albocreata is a white species with now and then individuals showing a yellowish tint over the center of the pileus, which is striate on the margin. The annulus is absent. The volva is circumscissile, the calyptra forming white floccose patches on the pileus, much as in *Amanita cothurnata* and *Amanita pantherina*. The lower part of the volva is ocreate, concrete with the base of the stem and fits it like the legging of a boot, but it is not so prominent, nor does it extend so high up on the stem as is usual

* In 1905. The determination was confirmed by E. Boudier.

† See Coker, W. C. Jour. Elisha Mitchell Sci. Soc. **33**: 1–88. 1917.

‡ *Amanitopsis albocreata* Atkinson, Jour. Mycol. **8**: 111. 1902.

§ *Amanita velatipes* Atkinson, Stud. Am. Fungi, Mushrooms, etc. 1st edition, p. 63. *f. 64–67*. 1900; 2d ed. 1901.

in *Amanita cothurnata*. Sometimes a portion of the thin marginal area of the calyptra may adhere to the rim of the ocrea, and thus resemble the volva limb of *Amanita jonquillea*, which is not ocreate but sheathing. In the latter species the volva is partly circumscissile and partly apical in its dehiscence. The volva is thin and weak. A portion of the calyptra margin remains at the base as a thin, free, sheathing limb, while the remaining portion rests on the pileus in the form of floccose patches. But the essentially differential feature in respect to the volva here is that the lower portion is not ocreate as it is in *Amanitopsis albocreata*. This feature can be seen in the lantern views presented here, from photographs of *Amanita jonquillea* which I made from specimens collected by me in the Maritime Alps, at Berre-des-Alpes, near Nice, in 1905 and also in 1910. The pileus of *Amanita jonquillea* is pale yellow, about the color of jonquils, and the margin is striate. The spores of *Amanitopsis albocreata* are globose to subglobose, while those of *Amanita jonquillea* are ellipsoid, as shown in these reproductions from photomicrographs of the spores.

A thin partial veil and an annulus are present in *Amanita jonquillea*. The veil is quite thin and sometimes it is so torn during the expansion of the plant that a distinct annulus is not present. In rare cases a delicate annulus may be present in *Amanitopsis albocreata*. But in my numerous collections of this species I have not observed one. However, in all species of *Amanitopsis* which I have studied in the fresh state, the ground tissue is present, which, in many species of *Amanita* at least, forms the partial veil and annulus. This has been demonstrated in *Amanitopsis vaginata* through a study of the development of this species.* As I pointed out at that time, the distinction between the genera *Amanita* and *Amanitopsis* is probably not a natural one. There are several species of *Amanita* (and *Amanitopsis* also) in which the presence of an annulus is variable. The ground tissue forming the partial veil, though sometimes abundant, possesses a very low degree of coherence, with the result that sometimes an ephemeral annulus is present and at other times it is absent. The facts that a distinct annulus is sometimes wanting

* Atkinson, G. F. The development of *Amanitopsis vaginata*. Ann. Myc. 12: 369–392. *pl. 17–19*. 1914.

in *Amanita jonquillea*, that there is a tinge of yellow in the pileus of some individuals of *Amanitopsis albocreata*, with variability in some of the other characters, are responsible for the opinion expressed as to the specific identity of these two species. Each species has its own range of fluctuating variation. The fact that at the extremes of the range of fluctuating variation one or more of the characters in different species overlap is not evidence of their specific identity.

Now we come to *Amanita velatipes*, another species which is confused with *Amanita jonquillea et al.* This is a large and robust species, about equal in size to *Amanita muscaria.* The pileus is usually hair-brown, or umber-brown, sometimes with a tinge of lemon-yellow, or rarely entirely maize-yellow. The remaining parts are white. The volva is thick and distinctly circumscissile. The calyptra breaks into concentric rings, especially near the margin, and these transversely into irregular areolate patches, which are usually firm and compact. They are easily freed from the viscid pileus and commonly warp up around the edge and may thus soon fall away. The lower portion of the volva remains concrete with the base of the stipe and is often ocreate. But more commonly the continued elongation of the stem severs it once or twice more in a circumscissile manner, thus leaving one or two stout rings above the bulb. These rings are more rarely checked transversely into coarse warts, in robust specimens, approaching then the usual condition in *Amanita muscaria.* The partial veil is ample and adheres very firmly to the stipe. It is easily freed from the gills but clings firmly to the margin of the pileus, for a time, and as the plant expands the veil is ripped off the surface of the stipe and forms an inferior or median annulus. The spores are oboval and inequilateral in profile, and when mature contain a large oil drop.

It is difficult to understand a concept of species which would unite *Amanita velatipes* with *Amanita jonquillea.* Its relationships are far closer to *Amanita pantherina* and *Amanita muscaria.* The smaller forms are exceedingly difficult to distinguish from *Amanita pantherina.* Or, shall we say that large forms of *Amanita pantherina* are difficult to distinguish from *Amanita velatipes?* I have several times collected, in the vicinity of Ithaca, a large white *Amanita* which might be taken for a white form of either

Amanita velatipes or *Amanita muscaria*, If *Amanita velatipes* is synonymous with *Amanita jonquillea*, then *Amanita muscaria* and *Amanita pantherina* must be thrown into the same "melting pot"!

Two more species remain to be discussed at this time, which have been misunderstood, and consequently united, in the two recent treatments of the Amanitas in this country. These are *Amanita Frostiana* and *Amanita flavoconia*.*

Amanita Frostiana† is a beautiful species described by Peck in 1883. This description is brief but very accurate and illustrates in a striking manner not only Dr. Peck's powers of observation, but his critical and analytical mind. It is a rather unique procedure, in a work of a monographic nature, in writing a diagnosis of *Amanita Frostiana*, to ignore this original description by Peck, and as it appears, leave out of consideration altogether any individuals which represent this species, and deliberately draw up a description of *Amanita Frostiana* from individuals recognized as *Amanita flavoconia*, a very different species.‡ *Amanita Frostiana* is a small to medium-sized plant. The pileus is orange or yellow, and distinctly striate on the margin. The volva is circumscissile in dehiscence. The calyptra is separated into numerous floccose patches on the surface of the pileus. The lower part of the volva is ocreate. The stem and partial veil are yellow. The spores are distinctly globose.

Amanita flavoconia§ is also a small to medium-sized species. The colors are much as in *Amanita Frostiana*. But it differs from *Frostiana* in its *smooth, not striate* pileus, in its smaller, oboval to subellipsoid spores, and in its volva *all friable*. The lower portion of the volva, that which remains over the base of the stem, is in the form of a fine yellow powder, with not the slightest suggestion of an ocrea. The lower part of the stem broadens gradually to the bulb, except in rare cases when, under certain unfavorable environmental conditions, somewhat depauperate forms may result, in which the transition from the stem to the bulb is abrupt.

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* See Murrill, W. A. Mycologia **5**: 76. 1913, and N. Am. Fl. **10**: 74. 1914. Coker, W. C. Jour. Elisha Mitchell Sci. Soc. **33**: 65. 1917.

† *Agaricus Frostianus* Peck, N. Y. State Cab. Nat. Hist. **23**: 69. 1872.

‡ See Coker, W. C. Jour. Elisha Mitchell Sci. Soc. **33**: 65. 1917. But it is quite possible his specimens were not typical *flavoconia*, but belong to a different species.

§ *Amanita flavoconia* Atkinson, Jour. Myc. **8**: 110. 1902.

But even under these conditions there is no evidence of an ocreate volva. Moisture frequently holds portions of the calyptra in definite patches, but its texture is different from that of the volva in *A. Frostiana.* In very rare cases, when the weather conditions are somewhat drying, the margin of the pileus may be slightly striate, as sometimes occurs with thin pilei, which normally are not striate. But this rarely appearing striate margin in *Amanita flavoconia* is one of the extreme limits of its range of fluctuating variation, not at all an indication of its specific identity with a normally and regularly striate species. But aside from this feature, the very different spores, and volva, separate *flavoconia* very clearly from *Frostiana.* It is more closely related to *Amanita muscaria*, or the form sometimes called *formosa.*

For a number of years, before I made a critical study of *Amanita flavoconia*, I regarded the specimens of this species which I encountered as belonging to *Amanita Frostiana.* I remember that in 1902, when collecting and studying fungi for a week, in company with Dr. Peck in the vicinity of Lake Piseco, in the Adirondack mountains, I showed him some specimens which I had collected during the morning, and said: "Here is an undescribed species of *Amanita.*" He examined the specimens critically for a few minutes and then said: "Yes, it is. Heretofore I have taken it for *Amanita Frostiana.*" *Amanita flavoconia* appears to have a much wider distribution than *Amanita Frostiana* has. It is very common in the Adirondacks; in fact, it appears to be the most common species of *Amanita* in that region, while I have never found *Amanita Frostiana* there, though it is not uncommon in the Cayuga region, and probably in all of central and western New York.

The range of fluctuating variation presented by some of the characters of these, and many other species of *Amanita*, is such that one extreme of the range in a species may now and then show a tendency toward the constant character of the corresponding structure in a related species. In this way the ranges of fluctuating variations are linked by this touch, or slight overlapping, of the extremes of all the species. If this relation of the ranges of fluctuating variation, between the different species of *Amanita*, is interpreted as indicating specific identity, it would result in reducing all the *Amanitas* to a single species.